NI-Spektral Delay

Operation Manual

NI-Spektral Delay
English

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Table of Contents

Factory Presets

Native Instruments wants to thank all people who were involved in the development of this product. The NI-SPEKTRAL DELAY is shipping with a lot of factory presets. They were created by renowned sound designers and musicians. The following list contains all preset banks and the name of the sound designers who created them:

Prest Bank:	Designed by:	Samples by:
Guitar	Craig Anderton	Craig Anderton
PianoLoop	Craig Anderton	Craig Anderton
Vox_Miami	Craig Anderton	Craig Anderton
FreQ_Distortions	FreQ Laboratories	NI
FreQ_Gates	FreQ Laboratories	NI
FreQ_Pan	FreQ Laboratories	NI
MCombs	Jake Mandell	Jake Mandell
MGeneral	Jake Mandell	Jake Mandell
MPipes	Jake Mandell	Jake Mandell
MResons	Jake Mandell	Jake Mandell
MUtils	Jake Mandell	Jake Mandell
DNB	Joerg Holzamer	NI
Hip	Joerg Holzamer	NI
House	Joerg Holzamer	NI
Spektral Vox	Joerg Holzamer	NI
KBeatBake	Kent Clelland	e-LAB
KFunk	Kent Clelland	e-LAB
KJungle	Kent Clelland	e-LAB
KOlSkool	Kent Clelland	e-LAB
KResonator	Kent Clelland	e-LAB
Drones	Len Sasso	Best Service
SFX	Len Sasso	Best Service
Tutorial	Len Sasso	Best Service
VexBoogie	Omar Torres	Omar Torres
VexBounce	Omar Torres	Omar Torres
VexFunk	Omar Torres	Omar Torres
VexHouse	Omar Torres	Omar Torres
FemaleVox	Uwe G. Hoenig	Best Service

Thanks to the following Sample-CD manufacturers for their friendly support:

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80802 München Tel: 089-345026

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info@bestservice.de

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Byggmästareg. 5

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SWEDEN

Tel: Int+46-411-521 202

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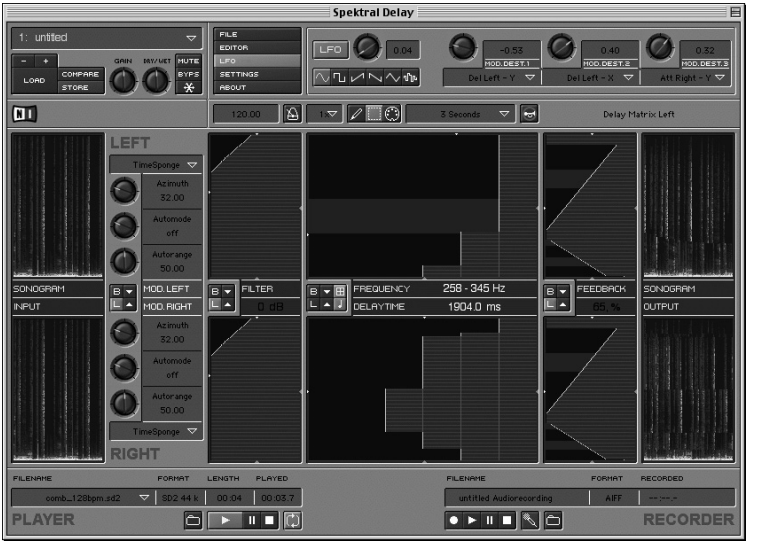
The NI-Spektral Delay User Interface



NI-Spektral Delay

Introduction

The Native Instruments NI-SPEKTRAL DELAY offers revolutionary possibilities for spectral sound shaping in realtime. Due to the combination of intuitive handling and very complex signal processing the NI NI-SPEKTRAL DELAY opens a new dimension of creative sound design. The NI-SPEKTRAL DELAY is an invaluable tool for the studio and is especially useful for sounddesign. Furtheris uniquely suited to use in Live Performances or as DJ tool.

What does the NI-Spektral Delay do?

In short, the NI-SPEKTRAL DELAY divides a sound into as many as 1024 frequency bands and then effects, filters, delays, and feeds back each band seperately. Before we can explain further what the NI-SPEKTRAL DELAY *does*, it is necessary to explain how the NI-SPEKTRAL DELAY is *different*.

Until now, virtually all realtime computer effects have operated in the Time Domain. The source of NI-SPEKTRAL DELAY's power lays in the mysterious Frequency Domain. Digital music that we have been familiar with until now, including CDs and hard disk recorders, all store and manipulate data in the Time Domain. Instead of relying on that aging format, the NI-SPEKTRAL DELAY converts every audio signal it receives into the Frequency Domain, gives you complete control over the Frequency Domain transformations, then resynthesizes a Time Domain sound that a normal computer can play.

The NI-SPEKTRAL DELAY operates on a mathematical representation of a sound's spectral content which we refer to as a spectral analysis. The spectral analysis data represents the magnitude of a given set of frequency bands at regular intervals of the audio signal. This analysis can then be converted back into the Time Domain through the process of spectral resynthesis.

The interesting part of this analysis / resynthesis paradigm is what happens in between these two operations. Now that affordable computers are fast enough to perform the required CPU-intensive calculations, the NI-SPEKTRAL DELAY can open the doors to new worlds of creativity in realtime processing.

In a typical NI-SPEKTRAL DELAY patch the audio will be analyzed into 512 frequency bins, each of which can be attenuated individually and fed into a delay-feedback network. This same patch in an analog studio would require 512 band pass filters and 512 individual delays with feedback. On top of that, the NI-SPEKTRAL DELAY offers an input modulation section with the ability to manipulate, modulate, and distort the 512 frequencies before they enter the filter banks and delays. In combination with the visual representation of the spectral analysis (sonogram) and graphic editors for manipulating the spectrum, the NI-SPEKTRAL DELAY is a groundbreaking tool that will prove invaluable in any studio situation from mastering to sound design.

The Structure of the NI-Spektral Delay

You will get the most out of NI-SPEKTRAL DELAY when you understand the overall signal flow and how each of the individual function groups work together. An important factor to note is which sections of the signal flow are in the Time Domain and which are in the Frequency Domain.

In the Time Domain, audio signals are organized into sample frames (or blocks). The host program (for example CubaseVST) streams sample frames into the plugin, and then the NI-SPEKTRAL DELAY performs the spectral analysis at this input stage. Through this analysis, the sample frame is transformed into a Spektral Frame. For each analyzed frequency band in the Spektral Frame, two types of information are stored: magnitude ("loudness" or "amplitude" of the frequency band) and the corresponding phase of the frequency band. (See "Spectral Analysis/ Synthesis" on page 54.). From this analysis data, the NI-SPEKTRAL DELAY is capable of resynthesizing the original audio signal, or more usefully, manipulating the frequency bands in order to change the output audio signal.

NOTE : The spectral analysis and resynthesis settings are by default set by the NI-SPEKTRAL DELAY so that you can begin immediately having fun restructing your sound. By changing the analysis/resynthesis setting (in the 'Settings' panel) you can dramatically change the overall sound of the NI-SPEKTRAL DELAY See "Input Modulation Stage" on page 9.. To learn more about how the factory presets and the audio demos work, it is recommended to begin with the following section.

Quickstart

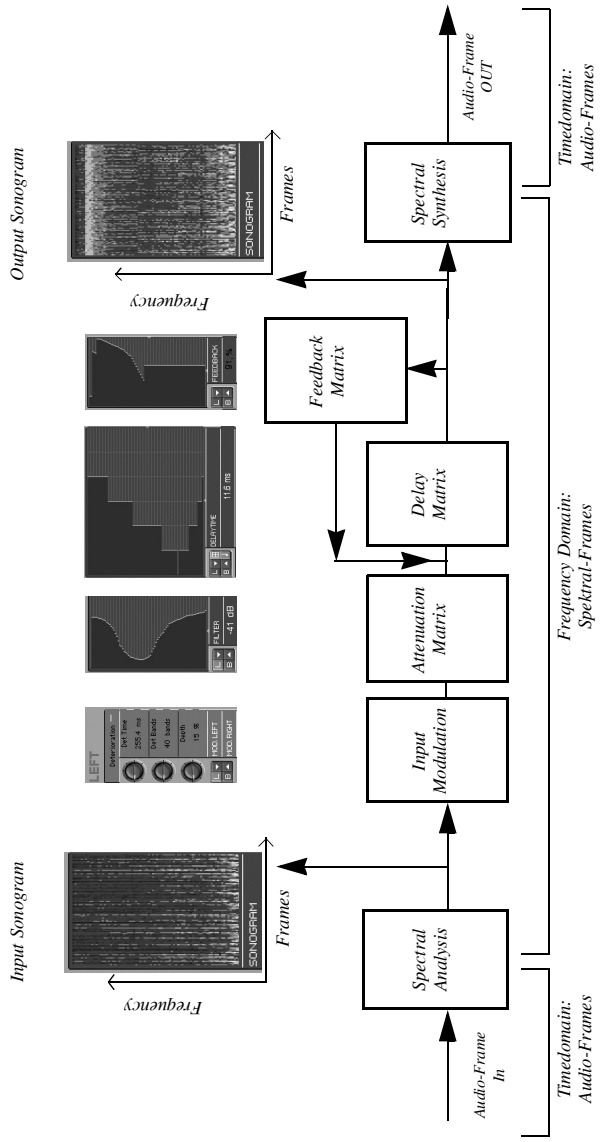
If you want to jump right into NI-SPEKTRAL DELAY, read this section first for a guided tour.

To start, launch the NI-SPEKTRAL DELAY standalone version by double clicking its program icon.

Don't be intimidated by all the control NI-SPEKTRAL DELAY offers you. You will become familiar with the NI-SPEKTRAL DELAY soon, but first let's open some preset banks.

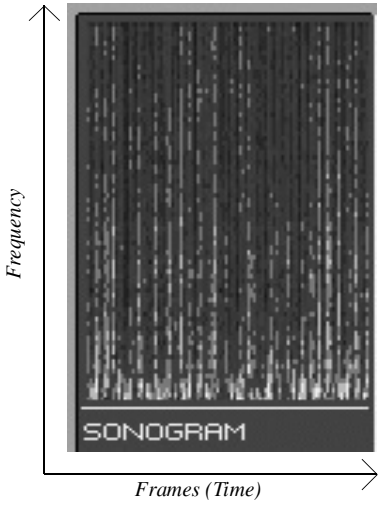
- Choose the "FILE" editor panel and then click the folder icon in the upper right.
- In the dialog box which appears, choose the folder NI-SPEKTRAL DELAY DEMO, which was installed in the main NI-SPEKTRAL DELAY folder. In this folder you will find many different preset banks to explore.
- Choose one of the preset banks (file extension .sdb) by double clicking it. The names of the presets in that bank will apear in the bank browser section of the File editor panel. An audio file should also begin to loop once you've selected a preset bank.
- In the pop-up menu next to the folder icon you can select between the various preset banks, each with a matching audio file carefully designed to showcase the features of the preset bank.
- Please note that each bank can contain up to 64 presets, of which only 16 are visible at once. Click on the "A B C D" buttons to page through all 64 presets in groups of 16.

Try to find out how NI-SPEKTRAL DELAY works by modifying the preset programs. The NI-SPEKTRAL DELAY was designed as a performance tool, so feel free to tweak and draw to your heart's content. Explore the functionality of the different editors and soon you will be creating your own killer presets. It could also be a useful learning tool to come back to preset exploration after reading through the entire manual, so you can see some of the technical tricks used by the presets. For loading and saving your own settings See “File Panel (Loading and saving of Programs)” on page 28. and See “Global Control Box” on page 24..



Functional structure of the NI-Spektral Delay

The Input Sonogram

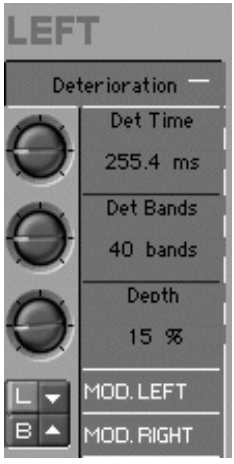


The Input Sonogram is a representation of the spectral contents of the input signal over time. Each vertical line is a snapshot of the frequency content of one frame. The currently playing frame is displayed on the leftmost column and scrolls to the right over time. The frequencies are laid out vertically, with the lowest frequencies on the bottom and the highest on the top.

The brighter the pixel color, the louder that frequency band is. The sonograms are always displayed with the same vertical resolution as the editing matrices. By rolling the mouse around inside of any of the edit matrices and watching the 'Frequency Band' display you can determine exactly which frequencies correspond to which vertical pixel. Because the frequency data is so much more detailed that a computer screen can properly display, different 'masks' (linear and logarithmic) are provided to view and edit the data (see also Analysis Bands on page 35).

NI-SPEKTRAL DELAY's audio processing has priority over the calculation and display of the sonograms, and so factors such as CPU performance and the demands of any other currently running (Host) programs can effect the performance of the animated sonograms. Even if the sonograms are running slowly or jerkily, rest assured that the sound quality of NI-SPEKTRAL DELAY will not be effected.

Input Modulation Stage



Input Modulation Stage

The first level of processing after the Spektral Analysis is the input modulation stage. An input modulation is much like an insert plugin that acts before the rest of the NI-SPEKTRAL DELAY's processing. Using the drop-down menu you can select between various algorithms which manipulate the analysis data directly.

It is important to note that because the input modulations are operating exclusively on the spectral analysis data, the ANALYSIS SETTINGS play a very important role in how these algorithms sound.

After selecting an algorithm from the drop-down menu, knobs will appear offering access to the modulation's parameters. The individual input modulation algorithms are described in detail in See "Input Modulation Stage" on page 9..

You can couple the left and right channels together with the 'Link' button (L) which lies between the two input modulation modules. By default the input modulations are linked.

By using the Bypass (B) button, you can bypass the input modulation stage. Note that both channels will be bypassed. The input modulation stage will also act bypassed if no input modulation is selected.

You can copy the settings of one channel to the other with the Copy-Up and Copy-Down arrows. If the two channels are linked together, then the Copy-Up and Copy-Down arrows will have no effect as all changes you make in either channel will automatically be made to the other channel as well.

A Brief Introduction to the Edit Matrices (Graphs)

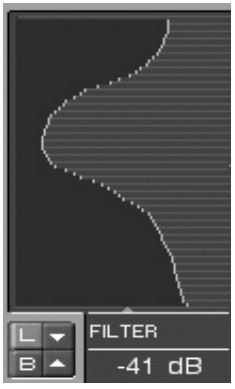
Much of the functionality of the edit matrices is common to all three stages (Attenuation, Delay, Feedback). In every case the frequency dimension is oriented on the Y (vertical) axis with the low frequencies at the bottom and the highest frequencies at the top. By moving the mouse up and down in any of the edit matrices you will notice that the frequency display shows you the frequency band for that mouse position. Each edit matrix also has a display for its X (horizontal) axis and is labelled in the measurement unit of that particular edit matrix (dB, Delaytime or % Feedback). When the mouse is within the boundaries of an edit matrix, its X display will show the X value for the current position of the mouse in white text. [**white text = current mouse position]** However when the mouse is not inside the boundary, but is inside another edit matrix, the X display will show the setting of the current frequency band in black text. **[black text = current setting at mouse Y position]**

With the Link buttons (L), which lie between the two edit matrices, you can couple the left and right channel settings. By default the edit matrices are linked.

By using the Bypass (B) buttons, you can bypass the edit matrices. Note that both channels will be bypassed.

With the Copy-Up and Copy-Down arrows, you can copy the settings of one channel to the other. If the two channes are linked, then the up and down arrows will have no effect as all changes you make in either channel will automatically be made to the other channel as well.

Attenuation-Matrix Editor

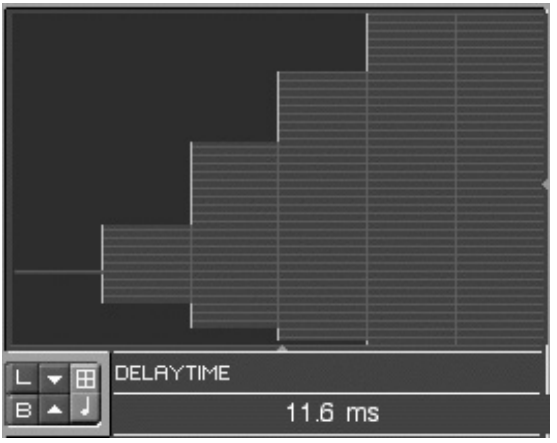


Attenuation-Matrix Editor

By using the mouse to draw into the Attenuation-Matrix Editor (filter bank) you can adjust the magnitude of the individual frequency bands. The amount of attenuation applied to the frequency is displayed in Decibels where it says 'Filter.' By moving the mouse around inside the edit matrix you will notice that the X (horizontal) axis represents attenuation, with unity gain being the leftmost value and × attenuation being the rightmost value. Consequently, by moving the mouse on the Y (vertical) axis you will notice that the display labelled 'Frequency' shows the corresponding frequency band for that position. As with all of the edit matrices, the lowest frequencies appear towards the bottom of the Matrix Editor and the highest frequencies appear towards the top.

Technical note: Larger analysis frames sound cleaner than smaller analysis frames. Smaller frame sizes produce a harmonic distortion which is inaudible at larger frame sizes.

Delay-Matrix Editor



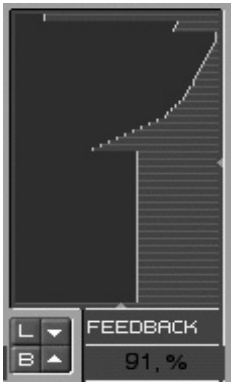
Delay-Matrix editor

By using the mouse to click or draw into the Delay-Matrix Editor you can set the delay of each frequency band. The delay time is displayed in millieseconds and no (zero) delay is oriented at the left edge of the edit matrix. The amount of delay available in the matrix is selectable between (approximate values) 375 ms, 750 ms, 1500 ms, 3 seconds, 6 seconds, and 12 seconds. The latter two options require significantly more memory (RAM) and are therefore only available by changing the preferences in the 'Settings' panel.

A tempo grid can be generated onto the delay matrix editor by selecting the grid size (quarter note, eighth note, eighth triplet, and sixteenth note). By activating Snap To Grid, the Pencil Tool will automatically be quantized to the selected resolution. The tempo grid can be synched externally to your sequencer or the tempo can be entered manually. By selecting 'Auto Quantize' in the 'Set-

tings' panel, when the tempo is slaved to an external source, the contents of the delay edit matrix will be automatically adjusted to remain locked to the tempo. In order for this to work your sequencer must support the transmission of time information.

Feedback-Matrix Editor



Feedback-Matrix editor

With the Feedback-Matrix Editor you can apply a unique feedback factor for each frequency. Feedack lies on the X (horizontal) axis with 0% feedback on the left edge and 100% feedback on the right. If you set a frequency band to 100% it will remain in the delay buffer for an indefinitely long time. In other words, it will get loud really quickly, so please be careful when playing with feedback values near 100%.

Tip: Using the feedback graph only has an audible affect when there is a delay drawn into the delay editor. With no delay you can have no feedback.

Tip: The NI-SPEKTRAL DELAY feedback algorithm functions a little differently than many delay machines of yesterday and even the digital loop machines of today because each frequency can have a different delay time. Try using the 'Freeze' button to capture a buffer of audio and manipulate the delay edit matrix. By creating feedback loop in which different frequency bands have different delay times, you can quickly turn an oridinary rhythmic pattern into a self-relational-phrase machine!

The NI-Spektral Delay Tools

The Editing Tools

The NI-Spektral Delay Editing Tools

Sync to Host Tempo

When the Sync button is activated, the NI-SPEKTRAL DELAY will slave to the tempo of the host program. If the host program does not support tempo synchronization, the Sync button will appear as disabled. When activated, the LFO will also sync to the external tempo.

The current tempo, which is the base for the calculation of the Tempo Grid, is displayed in Beats Per Minute (BPM) next to the sync button. This value can be manually edited.

The "Edit Mask" Setting

The "Edit Mask" describes the connection between visible editor content and the editor's effect on the internal analysis bands. In the Edit Mask you can choose between four different display modes of the Matrix Editors. You should choose the editing mode which is most appropriate for the source material:

1.) Linear Editing (1x):

The vertical frequency resolution in the Matrix Editors is equally spaced. For instance, since the range of frequencies that can be edited with the NI-SPEKTRAL DELAY is 0 to 22,000 Hz, 11,000 Hz would be exactly in the middle of the Matrix Editor's frequency scale. For the 160 pixels in the Matrix Editor's vertical (frequency) resolution, each pixel corresponds to exactly 137.50 Hz across the entire vertical range of the Matrix Editor.

While very precise editing can be done in the upper ranges, linear editing is not well suited for effects where accurate bass (low frequency) edits are desired, as between 137.5 and 275 Hz (one octave!), there is only one edit pixel.

2.) Adapted Editing (2x):

(only available if the number of analysis bands is higher than 80)

In Adapted Editing (2x), you have control of only 80 editing bands instead of the 160 in Linear Editing mode. Each edit band is always displayed with two monitor pixels, but each edit band can be assigned to one or more analysis frequency bands. The frequency display will always show you the current bandwidth of each edit band. The lower 30 edit bands are assigned to the analysis bands in a linear proportion of 1:1, while the remaining 50 edit bands each correspond to two analysis bands. Therefore you have more control over the low frequencies than is provided in the Linear Editing model, but less control in the higher frequencies.

3.) Adapted Editing (4x)

The 4x Adapted Editing mode works on the same priciples as the 2x mode, but only 40 edit bands are available, and likewise each edit band corresponds to four monitor pixels. Therefore you have even more control in the bass but proportionately less in the high frequencies.

4.) Logarithmic Editing

In the Logorithmic Editing mode, the low frequency bands in the graphs and sonograms are represented by more pixels than the higher frequency bands in order to give a more visually accurate perceptual model of the frequency relationships that we are ac-

customed to hearing. Logarithmic Editing is the most useful editing mode for traditional pitched material, as the frequences in the Edit Matrices correspond to the logarithmically perceived pitches of musical material.

Pencil Tool

By activating the Pencil Tool (cursor) you can, by clicking or clicking and dragging, affect any of the Edit Matrices. It is important to note that when using the Pencil Tool there are several modifier keys you can use to speed up the editing of the graphs. [these are different for Macintosh and PC]

MODIFIER KEYS (PC)

- **LEFT MOUSE:** Normal editing mode. Editing will occur on a 1:1 relationship to the mouse position.
- **LEFT MOUSE + SHIFT**: Line draw mode. By holding the shift key down while mousing in an edit matrix, a straight line will be rendered originating from where the LEFT mouse button was first pressed.
- **LEFT MOUSE + CONTROL:** With the control button depressed, the pencil cursor will set all Y values to the current X position and snap all automation settings back to their default position.
- **RIGHT MOUSE BUTTON:** By pressing the RIGHT MOUSE button you access the 'MIDI plug' cursor and can 'slide' the gesture around freely inside the edit matrix.
- **RIGHT MOUSE + SHIFT:** With the shift button depressed the 'HAND' cursor will be restricted to the Y (vertical) axis.
- **RIGHT MOUSE + CONTROL:** With the control button depressed the 'HAND' cursor will be restricted to the Y (vertical) axis.

MODIFIER KEYS (MAC)

- **MOUSE BUTTON:** Normal editing mode. Editing will occur on a 1:1 relationship to the mouse position.

- **+ SHIFT**: Line draw mode. By holding the shift key down while mousing in an edit matrix, a straight line will be rendered originating from where the mouse button was first pressed.
- **+ OPTION**: With the option button depressed, the pencil cursor will set all Y values to the current X position and snap all Automation settings back to their default position.

Attention : All MIDI automation settings are also reset to the default positions.

- **+ APPLE:** By holding down the APPLE key you access the 'HAND' cursor and can 'slide' the gesture around freely inside the edit matrix.
- **+ APPLE + SHIFT:** With the shift and apple buttons depressed the 'HAND' cursor will be restricted to the Y (vertical) axis.
- **+ APPLE + OPTION:** With the option and apple buttons depressed the 'HAND' cursor will be restricted to the X (horizontal) axis.

In contrast to the Automation tool no MIDI influence is generated here. Only the edit points in the editor are „moved".

Automation Tool

By activating the Automation Tool it is possible to edit the matrices' horizontal and vertical offsets. Both MIDI and automation data will be transmitted when using this tool, enabling you to record the movements with your sequencer program and play back the movements exactly as you performed them. Along the lower and righthand sides of the edit matrix you will notice two small white triangles. These triangles represent the current automation offset of the matrix. As you manipulate the matrix gesture with the Automation Tool, you will see that the pointers (triangles) move in accordance with the position of the cursor (when the mouse button is pressed).

MODIFIER KEYS (PC)

- **+ CONTROL**: With the control button depressed, the automation cursor is restricted to the X (horizontal) axis.
- **+ SHIFT**: By holding down the shift key the automation cursor is restricted to the Y (vertical) axis.

MODIFIER KEYS (MAC)

- **+ OPTION**: With the option button depressed, the automation cursor is restricted to the X (horizontal) axis.
- **+ SHIFT**: By holding down the shift key the automation cursor is restricted to the Y (vertical) axis.

The automation tool sends MIDI and automation data. Try record enabling a track in your sequencer, enabling the NI-SPEKTRAL DELAY as its input, and recording some movements into the track!

By double-clicking with the automation tool the automation offsets will be reset to zero.

Selection Tool

By activating the Selection Tool you can mark specific frequency bands for editing. By selecting specific bands, you can use the Selection Automation Tool to edit particular frequency bands individually (see modifier keys). The Selection Tool can also be used to mark bands to be transformed by the function generators in the Editor Panel. See “Function Generators” on page 32..

MODIFIER KEYS (PC)

- **+ SHIFT:** Add to selection (+)
- **+ CONTROL:** Remove from selection (-)
- **RIGHT MOUSE BUTTON:** Selection Automation Tool: Hand cursor for editing the selected frequency bands.

MODIFIER KEYS (MAC)

- **+ SHIFT:** Add to selection (+)
- **+ OPTION:** Remove from selection (-)
- **+ APPLE:** Selection Automation Tool: MIDI plug cursor for editing the selected frequency bands (see example below).

Note: To select nothing, double click inside the editor window.

Example: You want to delay a single frequency.

- Choose the Selection Tool.
- Click on the frequency band in the edit matrix you would like to effect.
- Hold the Apple key (right mouse button on PC) and drag the selected frequency band to the desired delay amount.

Frequency-Display

When the mouse is currently within the bounds of an edit matrix, the frequency (Y-axis) position of the mouse will be shown in this display.

Maximum Delay

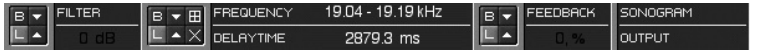
The pop-up menu titled 'Maximum Delay' allows you to select how much delay time is available in the delay edit matrix. The amount of delay available in the matrix is selectable between (approximate values) 350 ms, 750 ms, 1500 ms, 3 seconds, 6 seconds, and 12 seconds. The latter two options require significantly more memory (RAM) and are therefore only available by changing the preferences in the 'Settings' panel.

Delay Matrix Reset

In some situations it is desirable to delete the content of the delay memory completely. For instance, when VST playback is stopped and resumed later you may hear remnants of the previous delay buffer. You can clear the delay memory to solve this problem by clicking the Delay Reset button.

The Graph-Control Toolbar

The Graph-Control toolbar serves as simplification for the usage of the Matrix Editor. Here you can copy the content of an editor from one channel to the other or activate the Sanp function. Additionally the control display allows accurate editing.



The Graph Link Button

By activating the Link button, all actions occurring in one channel of the processing will automatically affect the opposing channel. The edit matrixes can be coupled or ‘linked.’

Graph Bypass Button

By activating the Bypass button for an edit matrix, that section of the NI-SPEKTRAL DELAY will only pass the uneffected signal.

Copy-Down Button

By clicking the Copy-Down button, the contents of the left channel will be copied into the right channel.

Copy-Up Button

By clicking the Copy-Up button, the contents of the right channel will be copied into the left channel.

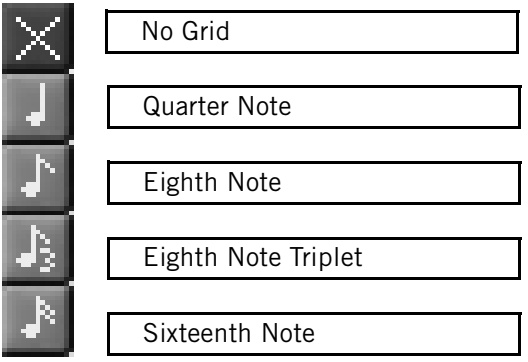
The Attenuation-Matrix dB Display

When the mouse cursor is inside of the Attenuation-Matrix (filter bank) the X axis position of the mouse will be shown in this display in white text. When the mouse cursor is within the bounds of the Delay-or Feedback-Matrix, the attenuation setting of the frequency band at the current Y-axis mouse location will be displayed in black text.

Snap Function

By activating the Snap to Grid button, mouse edits inside the Delay-Matrix Editor will be quantized to the current tempo grid (if one is selected).

With the button below the Snap to Grid button, you can select different tempo grid note-value quantizations. Below are the available selections:



Available resolutions for the Grid button

Technical note: The time resolution of the delay matrix editors is directly dependant upon the length of the analysis frames. With larger framesizes less accurate timing is a natural result. This problem can be rectified by increasing the overlap setting, but this requires twice the CPU processing power. In the case where a certain tempo resolution is not precisely accurate for a given frame size, the grid will be rounded to the next closest delay.

Delay Display

When the mouse cursor is within the bounds of the Delay-Matrix Editor, the Delay Display will show the delay value (X-axis) for the mouse position in white text. When the mouse cursor is within the bounds of an attenuation or feedback matrix, the delay setting for the current frequency band (Y-axis of the mouse) will be displayed in black text. Delay time is measured in milliseconds.

Global Control Box

Global Control

Naturally you'll want to save your work and recall it later. The NI-SPEKTRAL DELAY offers the possibility to store all parameter settings and edit matrix gestures into snapshots. A typical snapshot bank consists of 64 presets. However smaller bank sizes are set by default in order to enable the total recall of your session within the context of a host (sequencer program) data file. You can select how large the banks are with which you work in the 'Settings' panel. You can also export your banks to file and import them yourself later See "Settings Panel" on page 35.. It is important to note that in total NI-SPEKTRAL DELAY has 128 active memory slots for presets. The first 64 of these are what we refer to as Active Memory and are loaded and stored using the Global Control Box. The Active Memory contains the presets which will be stored automatically inside of host documents. ie when you save your CubaseVST song the Active Memory will be stored along with your song. Therefore if there is a limit to how much data can be stored within a host document, the Active Memory may be less than 64 presets. Active Memory presets send MIDI program changes 1-64. The other 64 memory slots are what we refer to as Disk Memory and are available through the 'File' panel. The Disk Memory snapshots send and recieve program changes 65 - 128. Disk Memory snapshots can be saved into Active Memory by activating the disk snapshot (by clicking on it) and pressing 'Store' in the Global Controls Box [note that the contents of the previous Active Memory slot will be overwritten without warning.

Saving a Snapshot

- Select a program space by clicking on the + / - buttons or click on the numeric program number, type in a value, and press enter.

- Click onto the text edit field containing the name of the program and give your program a name (and press enter).
- When you click the 'Store' button you will overwrite the contents of the selected program space without warning.

Loading a Snapshot Program

There are two ways of loading a snapshot from program memory:

- Simply click on the drop down menu icon, and select a preset from the menu.The previous settings will be directly overwritten and a MIDI program change message will be output.
- Select the desired snapshot using the + / - buttons or click on the numeric text and type in the preset number and press enter.
- When you click the 'Load' button the selected snapshot will be activated and begin effecting the audio signal. The previous settings will be directly overwritten and a MIDI program change message will be sent.

NOTE: The efficiency of NI-SPEKTRAL DELAY works in very close connection with the overall computer configuration, especially where sound-card drivers and host programs are concerned. Because of limitations of some computer configurations, it is possible that a preset created on one machine is not realizable at the same analysis/resynthesis resolution capabilities of another machine.

Dry/Wet Knob

Using the ‘Dry/Wet’ knob you can adjust the mix between the original audio input and the processed signal. When this knob is fully in its leftmost position only the unprocessed input signal will be heard (100% dry). Conversely when this knob is in its rightmost position the output signal will contain no unprocessed audio (100% wet). Predictably, in the center position the mix is 50:50.

Effect Gain Knob

With the effect ‘Gain’ knob you can apply + / - 24dB of gain to the output stage of the wet signal. Center position is unity gain.

Effect Bypass Button

When the Effect Bypass button (‘BYPS’) is activated the dry input signal will be sent directly to the output of the NI-SPEKTRAL DELAY. When bypass is active, the processing is still calculated so that when you de-activate the bypass button you will not need to wait to fill the delay buffers.

The Mute Button

The ‘Mute’ button silences the output of the wet signal. The ‘Mute’ button has no effect on the dry signal, if it is indeed mixed into the signal path.

Freeze Button

By pressing the Freeze button, the Attenuation-Matrix (filter bank) will be automatically set to the maximum attenuation where all bands are ‘closed’ or attenuated by -× dB. Simultaneously, the Feedback-Matrix will be automatically set so that all bands are feeding back into the Delay-Matrix at 100%. The practical effect of this is that a non-destructive infinite loop has been created, thus ‘freezing’ the audio See “Feedback-Matrix Editor” on page 13..

Hint: Try Freezing and editing the Delay-Matrix.

The NI-Spektral Delay Menu

In order to organize the various features and settings of NI-SPEKTRAL DELAY we have grouped them into five selectable control panels. Using the following selection buttons you can switch between the panels:

NI-Spektral Delay Menu

File Panel (Loading and saving of Programs)

File Panel

Read (loading Program/Program bank)

The "Read" function loads single programs or a program bank from disk. After pressing the "Read" button a dialog box appears, asking you to choose a file with one of the following extensions:

.sdp = NI-Spektral Delay program ; a single program

.sdb = NI-Spektral Delay bank ; program bank with up to 64 individual programs

---

Attention : The currently loaded program will always be overwritten by the new one when you load an individual program (.sdp).

Program banks are always loaded into the Disk Memory, while a single program always is loaded into the Active Memory.

Write PRG (Save Program)

The "Write PRG" function saves program to disk under the name you specify with the extension ".sdp".

Attention: If the program name appears in red, this indicates that the current program has been modified since last saved. In order to make sure that the current settings are remembered when you save the program to disk, make sure to click the "Store" button first.

Write BANK (Save Program bank)

The 'Write Bank File' button will open a save file dialog where you can save the entire contents of Active Memory to disk. Bank files will appear with the file extension '.sdb' .

The Bank Browser

The Bank Browser displays 16 of the current Disk Memory programs. Click on the "A B C D" buttons to page through all 64 presets of the Disk Memory in groups of 16.

Please note again the distinction between the Active Memory (Global Control Box, always visible in the top left of the NI-SPEKTRAL DELAY) and the Disk Memory (only visible in the FILE editor panel). It was necessary to make this distinction because only the Active Memory is saved with the VST host sequencer file. This is a limitation of the VST file format. In order to maintain consistency of design between the standalone and VST versions and to provide the full range of 128 MIDI program changes, the Standalone Version uses both Active Memory and Disk Memory.

To build custom NI-SPEKTRAL DELAY banks made up of your favorite preset patches, you can copy programs from Disk Memory to Active memory with the "Store" button in the Global Control Box. Be sure to choose a free memory location before hitting the "Store" button, as it will overwrite the current Active Memory preset.

All .sdb program banks which are located in the current directory are displayed in the pop-up "File" menu and are availabe to load into the Disk Memory.

To change the current directory of presets, click onto the folder symbol and load a new program bank in a different directory.

Editor Panel

Editor Panel

In the Editor Panel you can perform transformations of the six edit matrices. On the left hand side of the panel you will notice six selector buttons corresponding to the six edit matrices. By pressing a selection button the edit matrix will highlight to show that it is selected. The following abbreviations are used to represent the edit matrices:

Abbrev.	Matrix - Editor
ATT L	Attenuation-Matrix Editor Left
DLY R	Delay-Matrix Editor Right
FB L	Feedback- Matrix Editor Left

The first group of editor functions we refer to as ‘transformers’ because they have a direct immediate effect when you press them. They consist of smoothing, averaging, flipping on the X or Y axis, and quantizing (only in the case of the Delay-Matrix editor). The second group of functions can be thought of as ‘generators’ because they first calculate a mathematical function and then add that function to the selected edit matrix.

TRANSFORMERS

Quant (Quantize)

The Quantize function only works with the Delay-Matrix Editor. With the Quantize transformer you can snap a delay edit gesture to fit the current tempo grid. If no tempo grid is active the Quantize button will have no effect.

Smth (Smooth)

The Smooth function interpolates the contents of the selected matrix editor. By repeatedly clicking the ‘Smooth’ button the edit matrix gesture will approach a straight vertical line.

Avg (Average)

The Average function calculates the average between each two neighboring edit matrix points. Like the Smooth function, the Average function will also generate a straight line after many clicks. The Average function, however, only looks at the differences between two neighboring points, while the Smooth function looks at the shape of the entire edit matrix.

Fl X (Flip X / Mirror Horizontal)

Flip X mirrors the selected edit matrix gesture on the horizontal axis.

Fl Y (Flip Y/ Mirror Vertical)

Flip Y mirrors the selected edit matrix gesture on the vertical axis.

Function Generators

Attention ! When there are *no* selected (red) frequency bands in the current graph, all frequency bands will be effected by the generators. If there *are* selected frequency bands in the highlighted edit matrix then only the selected frequencies will be effected by the function generators.

After selecting an edit matrix, simply press one of the function generator buttons:

Math function

After the selection of a function generator, that function's corresponding text input controls will appear with default (or last used) values. Click on the text edit controls to modify these parameters. To apply the function to the selected graph, press the 'Go' button. To revert to your last settings press the 'Undo' button.

Table: Math-Functions

Sawtooth up

Parameter	Range	Description
amp	0-100%	amplitude in percent
per	0.0 - 512	period

Random

Parameter	Range	Description
max	0-100%	max. amplitude in percent

Sinewave

Parameter	Range	Description
amp	0-100%	amplitude in percent
per	0.0 - 512	period

Squarewave

Parameter	Range	Description
amp	0-100%	amplitude in percent
per	0.0 - 512	period

Sawtooth down

Parameter	Range	Description
amp	0-100%	amplitude in percent
per	0.0 - 512	period

Triangular wave

Parameter	Range	Description
amp	0-100%	amplitude in percent

LFO Controls

The Control-Panel

Using the LFO

The NI-SPEKTRAL DELAY is additionally equipped with an LFO (Low Frequency Oscillator). You can select between six different waveforms using the selection buttons on the left side of the panel. The LFO is only active when the 'LFO' button is highlighted (click to enable/disable the LFO). The speed of the LFO can be entered using the speed knob or the text entry field (LFO speed is in Hertz).

The LFO modulation can be assigned to a maximum of 3 parameters simultaneusly. These LFO assignments are selectable using the three drop-down 'Mod.Dest' menus. The depth of each LFO assignment can be adjusted using the the three provided knobs or typed directly into one of the three corresponding text entry fields. The assignment depth can be a value between -1.0 and 1.0.

The selection of LFO assignments follows:

LFO - Assigments
No Assignment
Attenuation-Matrix-Left X-Axis
Attenuation-Matrix-Left Y-Axis
Attenuation-Matrix-Left Selected
Delay-Matrix-Left X-Axis
Delay-Matrix-Left Y-Axis
Delay-Matrix-Left Selected
Feedback -Matrix-Left X-Axis
Feedback -Matrix-Left Y-Axis
Feedback -Matrix-Left Selected
Attenuation-Matrix-Right X-Axis
Attenuation-Matrix-Right Y-Axis
Attenuation-Matrix-Right Selected
Delay-Matrix-Right X-Axis

LFO - Assigments
Delay-Matrix-Right Y-Axis
Delay-Matrix-Right Selected
Feedback -Matrix-Right X-Axis
Feedback -Matrix-Right Y-Axis
Feedback -Matrix-Right Selected
Mod 1(Input Modulation Left Parameter 1)
Mod 2 (Input Modulation Left Parameter 2)
Mod 3 (Input Modulation Left Parameter 3)
Mod 4 (Input Modulation Right Parameter 1)
Mod 5 (Input Modulation Right Parameter 2)
Mod 6 (Input Modulation Right Parameter 3)

Settings Panel

Settings Panel

Analysis Bands

The NI-SPEKTRAL DELAY operates on sample frame blocks which are delivered by the host program or the sound card. This value is generally editable by most host applications or sound card driver utilities. The available frequency domain analysis/re-synthesis resolutions are directly calculated from the sample frame size of the host program or sound card driver. The default resolution is always:

Number of Frequency Bands N = (Sameple Framesize / 2)

The default resolution will always be the most CPU efficient setting. All other resolution selections will be an integral factor of 2 or a multiple of 2. For example, if the host program is configured to use a sample frame size of 512 samples per frame, the default NI-SPEKTRAL DELAY resolution will be 256 frequency bands. The selectable resolutions will be: 1024, 512, 256, 128, 64 frequencies per analysis frame.

NOTE: Setting the analysis / resynthesis bands to higher values proveds a cleaner audio quality. Lower resolutions can create audible harmonic distortions which are inaudible at higher resolutions.

IMPORTANT: if your sound card driver or host program allow you to configure the size of the audio sample frame (buffersize), the most efficent selection would always be a power of 2 (128, 256, 512, 1024...).

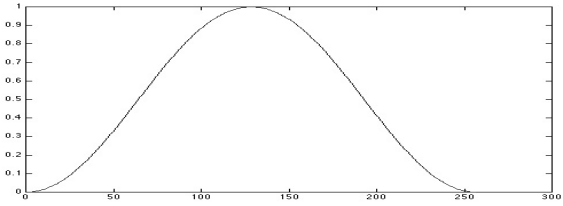
Overlap

In order to successfully resynthesize an analyzed audio signal it is important to window and overlap the audio sample frames. For a complete representation of the audio signal to be re-synthesized a minimum overlap of 1x is required. (this is the default setting). With an overlap of 0x the analysis data will be accurate, however if the signal is processed, the resynthesis engine will not be able to fully reconstruct the signal. We have left 0x overlap as an option knowing that it creates a severe distortion of the signal, mostly because this can be an interesting sound and is very cheap to process. An overlap of 2x will provide a much more time-accurate analysis as well as more accurate distribution of magnitudes. A double overlap, however, uses 200% of the CPU processing power of single overlap.

Windowing

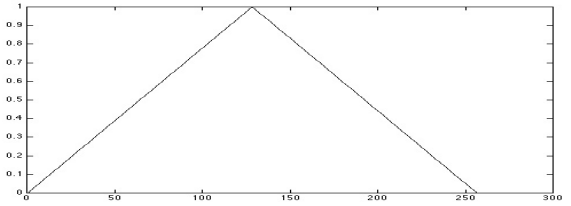
The windowing of the sample frame is a necessary tool of the analysis process, as it provides a scope, or range, of the complex signal (audio) within which we can measure our statistical data (amplitude and phase of each frequency). Mathematically speaking, the default window setting (Hanning) is the most effective for an overlap of 1x (also default). The other window shapes create interesting colourations of the frequencies and in some case harmonic distortions. They are available for your selection should you choose to be creative with such paramenters. Hanning should always sound the 'cleanest.'

Below is a diagram of each window shape:



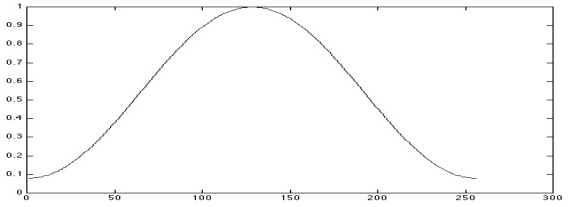
Hanning Window

NOTE: Although the Hanning window should always sound the ‘cleanest,’ we have provided other traditional windows for your experimentation. Although the mathematical explaination on the topic of windowing in spectral analysis is out of the scope of this manual, we have provided a reccomended literature list as an appendix.

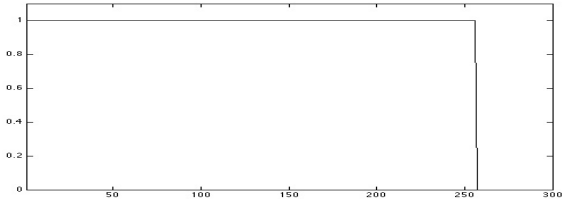


:

Triangle Window



Hamming Window



Rectangle Window

RAM allocation

In this drop-down menu you can set up memory specific behaviours of the NI-SPEKTRAL DELAY. The first group of options are regarding how much RAM is allocated for the delay matrices. By default the NI-SPEKTRAL DELAY will only allocate enough RAM for 3 seconds (3") of delay. If you would like to work with larger delay sizes you will need to select your setting and restart the NI-SPEKTRAL DELAY. If you are using the plugin version you will only need to 'unplug' the NI-SPEKTRAL DELAY and 're-plug' for the change to take effect. Note that the NI-SPEKTRAL DELAY plugin aquires its memory from the host application's RAM Heap. If there is not enough memory in the host's allocated RAM the NI-SPEKTRAL DELAY may fail to install with your preferred setting. The RAM requirements are as follows:

Minimal	(3“)	5 MByte
Normal	(6“)	9 MByte
Maximal	(12“)	17 MByte

General Settings (Preferences)

In „General Settings“ various options can be activated by selecting from the PopUp menu. Active options are marked by a tick on the left side. The following options are available:

- 'Zero Delay Matrix on Program Change:' when activated, this feature will automatically 'flush' the delay buffer every time you switch programs.
- 'Snapshot Isolate Wet/Dry Mix:' when activated, this feature will leave the wet/dry mix knob at its current setting even when new programs are loaded.
- 'Snapshot Isolate Gain:' when activated, this feature will leave the gain knob at its current setting even when new programs are loaded.
- 'Snapshot Isolate Tempo:' when activated, this feature will leave the tempo at its current setting even when new programs are loaded.

- ‘Auto Quantize:’ when activated AND the snap to grid function is turned on AND the sync to external tempo is activated, then when the tempo changes, the delay graph will automatically adjust the delays so they stay in tempo.
- ‘Store Analysis Settings with Program:’ when activated, this feature will store and recall the analysis settings with the program (Analysis Bands, Overlap, Window). This feature will only work if the the audio environment is similar (same sample frame size) as the environment the program was created on. Additionally, it’s important to note that when switching between analysis band sizes, a pause in the audio signal will occur. A switch to very small analysis band sizes can cause a long pause in the audio signal.
- ‘Ignore MIDI Reset Messages:’ Most host programs send a MIDI reset together with Start and Stop messages. In the NI-SPEKTRAL DELAY normally the current content of the delay memory is cleared. Using this option you can avoid that the Delay Memory is cleared automatically.

Information about the NI Spectral Delay

This panel displays general informations about the software. It doesn’t contain any user functions.

The Input Modulation effects

The following algorithms are available :

Deterioration

Algorithm:

Through pseudo-random operations, the Deterioration algorithm produces 'holes' in the spectral frames. By increasing the depth you can adjust how prominent the effect is.

Parameter:

Depth: Deterioration Depth is the measurement of how 'deep' the holes in the spectrum are, or how prominent the effect is (0% is no effect, 100% means that the generated holes will be zeroed.).

Frequency: The Deterioration Frequency is how many holes are generated per spectral frame.

Duration: The Duration parameter determines how long (through time) the holes are.

HINT: This modulation can produce interesting 'phasor' sounding effects, very interesting when used with different settings for each channel.

Jello Mold

Algorithm:
The Jello Mold algorithm is a spectral inversion algorithm. All frequencies with magnitudes over the given threshold will be affected. When a frequency is inverted, its magnitude is subtracted from the maximum amplitude of that frame. This can produce aggressively noisey results, but also when applied with proper threshold and gain settings can generate very interesting harmonic artifacts.

Parameter:

Threshold: The level at which the individual frequency band will be determined for processing. If the band's magnitude is over the threshold, that band will be effected.

Reverse Gain: Determines the scale of the inversion. [-oo no magnitude inversion/ 0dB maximal inversion]

PitchRoll

Algorithm:

The Pitch Roll shifts the frequency bands up or down. The results are similiar to ring modulation and create a definitive harmonic distortion.

Parameter:

Shift : Determines how many frequency bands you would like to shift. (Range: -128/+128)

Smear

Algorithm:

The Smear effect changes or "smears" the magnitude and phase values of the incoming audio signal. The original signal is still recognizable, but looses contour and harmonic structure depending on the effect intensity.

Parameter:

Depth : This parameter sets the effect intensity.

(0 % = no effect; 100 % = maximum effect)

TimeSponge

Algorithm:

Using the TimeSponge you can alter the sense of time of your input signal. The algorithm manages a memory buffer of spektral frames and re-organizes the input signal as it enters. Through continuous movement of the first parameter, you can elasticize your sound. The TimeSponge produces (beautiful) harmonic distortions.

Parameter:

Azimuth: Relative read-out position of the spektral memory in relationship to the current input frame.

NOTE: unless the Azimuth parameter is moving the TimeSponge sounds quite un-interesting (very boring). Try connecting your MIDI controller to this paramter (CC 66 or CC 69), or assign the LFO to modulate this parameter to start having fun.

Foam

Algorithm:

The Foam algorithm effects the enveloping of the spectral frames. This allows for very interesting spectral amplitude modulation effects. Frequency magnitudes will be multiplied by a mathematical function, similar to an LFO.

Parameter:

Depth: Modulation depth (0-100%)

Speed: Modulation frequency in Hertz

Function : Selection of Modulations function

Nr	Function
1	sawdown
2	sawup
3	square
4	triangle
5	sine

Lime Twist

Algorithm:

Lime Twist uses pseudo random numbers to re-order the frequencies of the incoming spektral frame over time.

Parameter :

max Twist : Determines how many frames a single frequency band can be randomly shifted.

Horse Tail

Algorithm

The Horse Tail is a kind of comb filtering effect but in the Frequency domain. It simply attenuates bands which do not lie on a modulo of the spread parameter. If the spread is 4 and the depth is 100% then only every fourth frequency band will be heard.

Parameter

Depth : The depth determines how prominent the effect is.

Spread : Determines the modulo for band attenuation.

Offset : Determines the first band effected. by turning up the offset you can effect the higher bands and not the lower ones.

TIP: try automating the 'Spread' parameter!

Mini-Pulses

Algortihm

Mini-Pulses is a frequency amplitude effect, comparable to a tremolo at fast speeds and a pulse-gate at slower speeds.

Parameter

Gain : When using the Mini-Pulses without the feedback parameter turned on, the output can be quite low. Applying gain to the effected signal helps to compensate for this.

Repeat Time : Determines how frequently the pulses occur (or how often the 'gate is opened').

Feedback : The pulsed signal can be fed back into itself in order to create more interesting harmonic features.

Imprint

Algorithm

The Imprint algorithm operates on the principle of a spectral gate [commonly referred to as a spectral sieve]. When the magnitude of a frequency band crosses a given threshold, that frequency band is allowed to pass through the gate, else the frequency band is rejected. By setting the 'Invert' parameter you can reverse the effect so that instead of the louder frequencies passing through the gate, the softer frequencies will pass.

Parameter

Depth: When the magnitude of a frequency band crosses the threshold value, it will be attenuated by the 'Depth' parameter.

Threshold: The relative threshold level which determines which frequencies will be attenuated and which will remain unaffected.

Invert : When invert is activated, frequency bands whose magnitudes are over the threshold will be uneffected. When invert is deactivated, frequency bands whose magnitude is under the threshold will be attenuated.

Phase Blaster

Algorithm

Scrambles the phase information of the spectral frame.

Parameter

Phase Magic: Determines how much scrambling is to occur.

The NI-Spektral Delay Stand-alone

Once you have installed and set up the NI-SPEKTRAL DELAY software, you are ready to use the program. Run the program by double-clicking the NI-SPEKTRAL DELAY application.

The NI-Spektral Delay Stand-alone menu

File Menu

Open

By selecting Open... you can load a NI-SPEKTRAL DELAY session file (file extension *.sds). All current settings (including stored presets and the current position of all controls) are recalled with the file.

Save

The menu item Save stores the current settings (including stored presets and the current position of all controls) as session file (file extension *.sds).

Save as...

The menu item Save as... also stores the current settings (including stored presets and the current position of all controls) as a session file (file extension *.sds). However, here you can specify a new filename for the file.

Exit

Exit closes the program and all its windows, including those in the task bar. Before closing, the software checks if any changes have been made since last saving and asks you what to do if it finds any unsaved changes.

System Menu

The various items in the System menu are for controlling the audio and MIDI inputs and outputs of the NI-SPEKTRAL DELAY.

Run/Stop Audio

With this menu item the audio computations can be started (Run Audio) and stopped (Stop Audio). This is the main on/off switch for the NI-SPEKTRAL DELAY software.

Audio Port

This menu item lets you toggle between several audio interfaces. Under Windows you can toggle between soundcard, which includes the Windows Direct Sound and MME, and ASIO drivers. On the Mac you can choose between Soundmanager and ASIO. Ports that are not installed are shown in gray in the menu, those that are installed are shown in black.

Audio Settings...

This menu item opens a dialog window in which you can optimize the performance of your audio hardware. See the Installation chapter for more informations about setting up you audio interface.

MIDI Settings...

This menu item allows you to choose which of the MIDI inputs and outputs installed on your computer are to be used by the software.

To select one or more inputs from which the NI-SPEKTRAL DELAY software should receive data, choose the appropriate in-port from the list of Available Ports and insert it into the list of Installed Ports by pressing Insert. If more than one input is installed, they will be active in parallel. Use Delete to remove a selected port from the list. The changes will become active after you click OK.

If you install the driver of a MIDI interface or a soundcard as an input to the NI-SPEKTRAL DELAY software, you can control the software from an external MIDI device connected to this input.

If you want to control the NI-SPEKTRAL DELAY from a MIDI program (e.g. a software sequencer) running on the same computer, you need a MIDI loopback driver. On the NI-SPEKTRAL DELAY installation CD you find Hubis loopback driver for instance, which you can use for Windows 95/98. After the installation of Hubis Loopback driver you will get four additional virtual MIDI ports in all your MIDI applications called LB1 to LB4. If you use a sequencer, choose LB1 as MIDI Out for the selected MIDI track and LB1 as MIDI input in NI-SPEKTRAL DELAY. In most situations, however, it will be easier to run the NI-SPEKTRAL DELAY as a plug-in from within a host sequencer environment.

To select one or more outputs to which the software should send MIDI data, choose the appropriate out-port from the list of Available Ports and insert it into the list of Installed Ports by pressing Insert. If more than one output is installed, the same data will be sent to all ouputs. Use Delete to remove a selected port from the list. The changes become valid on clicking OK.

HD-Recording Options...

Player/Recorder Settings

You can set a buffer size for the hard disk recorder. It is recommended to leave the buffer size at the recommended size of 64 kbyte. If you have performance problems during recording, try to raise the buffer size to 128 kbyte. The buffer size you can set here has nothing to with the buffer size of the audio card, it only effects hard disk recording performance.

Audio File Player

Audio File Player

The audio file player can be used to load audio files which can be played back and processed by the NI-SPEKTRAL DELAY. It reads the files directly from the harddisk.

Note: On both Mac and PC, you can use WAV as well as AIFF files. Nevertheless, since the NI-SPEKTRAL DELAY requires slightly higher CPU usage to convert the non-native file format, you would be better off using the native file format for your operating system, which is AIFF (and SD2) on the Mac and WAV on the PC.

Associating audio files with preset banks

The standalone version can associate audio files with bank file names. When there is an audio file located in the same folder as the bank file with the same name as the bank file (excepting the necessary file extension), the audio file will be be looped automatically when that bank is opened and will appear in the Pop Up Audio File Selector menu in the Player.

Select a folder and Pop Up Audio File Selector

The Select a Folder button defines a folder for the use of the audio file player. After pressing this button you will be asked to select an audio file. NI-SPEKTRAL DELAY will not only load the audio file you selected, but it will add all audio files in deeper directories to the Pop Up Audio File Selector in the Player. The name of the file as well as the format (wav or aif), the duration in seconds and the playback position are displayed.

Audio File Selector

Play

Pressing the Play button starts the playback of the currently selected audio file.

Pause

The pause button stops the playback of the selected audio file at the current playback position. With the Start button the playback of the audio file will proceed at the position the playback was paused.

Stop

This button stops the playback of the selected audio file and resets the playback position to the beginning.

Loop

Turn the Loop button on to endlessly loop the current audio file.

Recorder

Audio File Recorder

The Recorder records all sound coming out of the NI-SPEKTRAL DELAY to the hard disk and creates a file with the name you have specified. The audio file made by the Recorder will contain all effect processing including all realtime manipulation you do.

Note: If you have performance problems while recording an audio file, try to raise the buffer size for HD-Recording in the system menu.

Audio File Display

Audio File Display

As soon as you have specified a folder for recording with the Folder Selection button NI-SPEKTRAL DELAY will use this folder for all recordings. The name of the file as well as the format (wav or aif), the duration in seconds and the playback position is displayed. You can change the name of a recorded file or before you record a file by clicking on the current name and entering a new one.

Record

Immediately starts a recording into the folder you have specified on your harddisk. If a file with the same name already exists in the folder, you will be asked if you want to overwrite this file.

Play

Pressing the Play button starts the playback of the currently selected audio file.

Pause

The pause button stops the playback of the selected audio file at the current playback position. With the Start button the playback of the audio file will proceed at the position the playback was paused.

Stop

This button stops the playback of the selected audio file and resets the playback position to the beginning.

New Recording

Pressing this button creates a new file for recording. You can change the name before the recording or afterwards.

Select a folder

This button defines a folder for recording. After pressing this button you will be asked to open a folder for recording and to enter a name for the file you want to record.

Spectral Analysis/Synthesis

Spectral Analysis

In many aspects the human ear is functioning like a spectral analyzer. The incoming soundwaves (small variations of the air pressure, which are overlaying the atmospheric air pressure) are analyzed respectively their frequency decomposition. This information is passed to the our brain and represents our hearing impression. Mainly for that reason the „Spectral Representation“ of a signal has found many applications in Digital Audio. Most of these applications are based on the so-called Fourier Transformation.

The NI-SPEKTRAL DELAY is using a special case of the universal Fourier-Analysis, the „Short Time Fourier Transformation“ (STFT). The STFT is based on segmentation the incoming audiosignal in small blocks which we call audioframes. The frequency decomposition of each of this audioframes will be individually analyzed using the STFT.

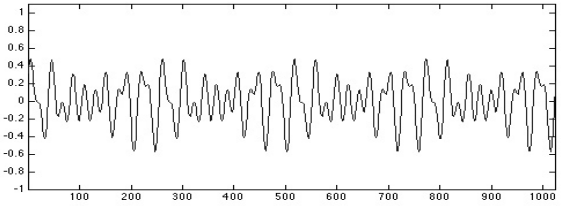
The result of the STFT analysis is a block of data which size equals to the size of the analyzed audioframe. Each block of spectral data contains exactly the same amount of information with the only difference, that this information is represented in another way. We dont deal anymore with audiosamples, describing the time characteristics of the audiosignal. The information is now stored in pairs of numbers describing the magnitude and the phase of one of the signals frequency components. According to the Fourier Theory a signal could be interpreted as the addition of individual sinusoidal components. Whereas the magnitude specifies the level of one siusoidal component, the phase is describing the offset in time to other frequency components.

The number of resulting frequency bands is *always* defined by the audioframesize :

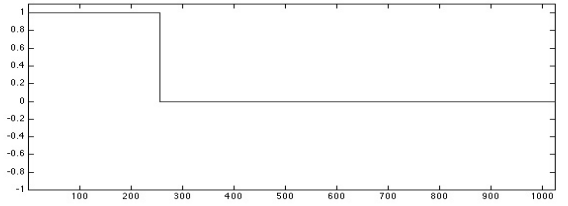
Number of Frequency BandsN = (Framesize/2)

E.g. an audioframesize of 512 audiosamples leads to a frequency resolution of 256 frequencybands and vice versa.

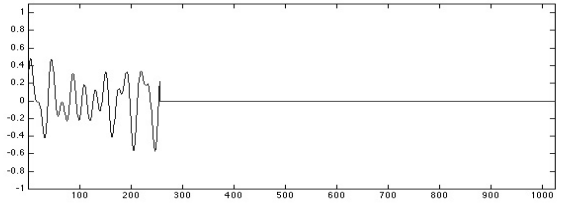
An Audioframe should be understood as a small part of the whole audiosignal. It is derived by multiplying the whole signal with a so call window function. The following graph represents a segment of a digital audiosignal (1024 Audiosamples)



By multiplying this with a rectangular wave window function (windowsize of 256 Audiosamples)



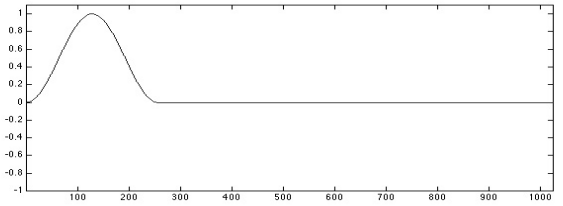
the result is a windowed „audioframe“ of 256 Audiosamples



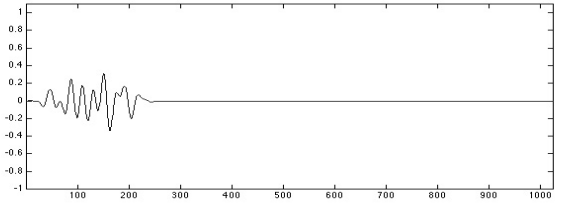
As long as the audiosignal is not modified it is easy to just concatenate all audioframes and getting back the original signal.

After modifications of the audioframe (the NI-SPEKTRAL DELAY does this in the frequency domain) we do have to deal with two problems. By concatenating the modified audioframes the resulting discontinuities at the frame limits will lead to audible clicks and distortion. To avoid this, two solutions are commonly used:

1. The use of non-rectangualer window functions e.g. the Hanning Window

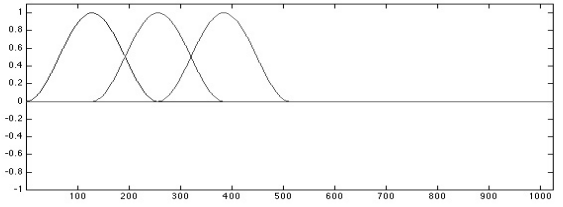


After windowing the audiosignal with this Hanning Window, the audioframe will look like this (No discontinuieties at the limits possible):



2. The overlapping of the windowed audio frames

The Frame Overlapping results in a nearly inaudible crossfade between the modified frames.



Each one of the windowed audio frames will then be transformed to a Spectral Frame by using the STFT Algorithm. We obtain the signal data in a form which allows us to modify it in the in the graphical Matrix Editors: The magnitude and the frequency band can be treated individually in many different ways....

Resynthesis

After all modification stages, the Spectral Frame has to be transformed back into Time Domain via the inverse STFT. The shape of a modified audioframe could differ now significantly from the original one. As mentioned before, the simple concatenation of the backtransformed audio frames would lead to audible discontinuities at frame limits. To avoid this, we have to multiply each frame again with a window function, before they are concatenated. Additionally, we don't really concatenate, we overlap them. This overlapping is unavoidable but could only be realized with a certain delay of the input audiosignal. That means, the output signal is delayed respectively the input signal. The resulting system delay is mostly dependent on the chosen number of Analysis Bands page 57 in this chapter.

Aliasing !

The Attenuation Matrix Editor is not totally comparable with a common time domain filter. By using small Framesizes and strong modifcation of the audiosigal some aliasing effects can occur. Aliasing means that some artefacts (mirrored frequencies) are added to the signal, which can't be filtered out. This is not a software bug but, it's dued to the properties of the Fourier Transformation. Because of the huge processing power needed to avoid aliasing, we decided, not to implement yet an Antialiasing Function in this Spektral Version 1.0.

Systemdelay and Framesize

The Systemdelay d (Latency) is calculated in Samples and is depending on the following parameters :

- internal Framesize (d.h. 2 x Number of Analysis Bands)
- external Framesize (defined by the Host)
- Overlap

if Internal Framesize <= External Framesize :

$$d = \mathbf{Framesize}(int) - \frac{\mathbf{Framesize}(int)}{\mathbf{Overlap + 1}}$$

if Internal Framesize > External Framesize :

$$d = 2 \cdot \mathbf{Framesize}(int) + \frac{\mathbf{Framesize}(int)}{\mathbf{Overlap + 1}} - \mathbf{Framesize}(ext)$$

The dry Outputsignal of the NI-SPEKTRAL DELAY is automatically delayed respectively the Effect Outputsignal, in order to not have any phase shifts in the Dry/Wet Mix.

MIDI-Implementation

Assignment table of MIDI Controllers

Controller Nr.:	Assignment :
1	LFO Speed
2	LFO Depth 1
3	LFO Depth 2
4	LFO Depth 3
5	LFO On/Off
6	Dry/Wet Mix
7	Effekt Gain
8	LFO Assign 1
9	LFO Assign 2
10	LFO Assign 3
11	LFO Shape
12	not assigned
13	not assigned
14	Effect Bypass
15	Effect Mute
16	not assigned
17	Modulation Bypass
18	Attenuation Matrix Editor Bypass
19	Delay Matrix EditorBypass
20	Feedback Matrix Editor Bypass
21	not assigned
22	not assigned
23	not assigned
64	Freeze On/Off
66	Input Modulation L Parameter 1
67	Input Modulation L Parameter 2
68	Input Modulation L Parameter 3
69	Input Modulation R Parameter 1
70	Input Modulation R Parameter 2
71	Input Modulation R Parameter 3
72	X-Transposition Attenuation Graph L
73	Y-Transposition Attenuation Graph L
74	X-Transposition Delay Graph L
75	Y-Transposition Delay Graph L
76	X-Transposition Feedback Graph L
77	Y-Transposition Feedback Graph L
78	Selection Transposition Attenuation Graph L

Controller Nr.:	Assignment :
79	Selection Transposition Delay Graph L
80	Selection Transposition Feedback Graph L
81	X-Transposition Attenuation Graph R
82	Y-Transposition Attenuation Graph R
83	X-Transposition Delay Graph R
84	Y-Transposition Delay Graph R
85	X-Transposition Feedback Graph R
86	Y-Transposition Feedback Graph R
87	Selection Transposition Attenuation Graph R
88	Selection Transposition Delay Graph R
89	Selection Transposition Feedback Graph R